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# TECHNICAL SPECIFICATION FOR 11 KV XLPE POWER CABLE OF SIZE 3X185 mm2 (CROSS LINKED POLYTHELENE DRY GAS CURED)

## SECTION - I

**1.1 SCOPE:**

1.1.1 This Section of the Specification covers design, manufacturing, testing, packing, supply & delivery of 11 KV XLPE Dry gas cured insulated power cable for effectively earthed specification system.

**1.2 STANDARDS:**

1.2.1 Unless otherwise specified, the cable shall conform in all respect to **IS: 7098 (Part-II)-1985** with latest amendment thereof.

**1.3 CLIMATIC CONDITIONS:**

1.3.1 The climatic conditions under which the cables shall operate satisfactorily are as follows:

| | | | | |
|---|---|---|---|---|
| (a) | Maximum ambient temperature of air | $^0$C | : | 50 |
| (b) | Minimum ambient temperature of air in shade | $^0$C | : | 4 |
| (c) | Maximum daily average ambient temperature | $^0$C | : | 40 |
| (d) | Maximum yearly average ambient temperature | $^0$C | : | 30 |
| (e) | Maximum relative humidity | % | : | 95 |
| (f) | Average number of thunder storm days per annum | | : | 15 |
| (g) | Average annual rainfall | cm | : | 150 |
| (h) | Maximum wind pressure | Kg/cm$^2$ | : | 150 |
| (i) | Altitudes not exceeding above MSL | mtrs. | : | 1000 |
| (j) | Maximum soil temperature at cable depth | $^0$C | : | 30 |
| (k) | Maximum soil thermal resistively | $^0$C cm/watt | : | 150 |

**1.4 PRINCIPAL PARAMETERS:**

1.4.1 11 KV (E) Grade XLPE, 3-Core, power cable shall be of high conductivity, stranded compacted, H.D. aluminum circular shaped conductor with XLPE (cross linked Poly Ethelene) Dry/Gas cured insulation provided with

shielding of extruded semi-conducting materials over conductor and XLPE insulation. Each insulated core shall have copper tape screen, laid together and provided with common covering of PVC Inner Sheath (Extruded). Overall galvanized steel strip armour and PVC outer sheath shall be provided.

The specification for manufacture of cable shall be conforming to IS: 7098 (Part-II) 1985 (latest edition) for 11KV (E), 3-phase, 50 Hz. Earthed systems.

1.4.2 Outer sheath shall be designed to afford high degree of mechanical protection and shall also be heat, oil, chemical and weather resistant, Common acid, alkalis and sealing solution shall not have adverse effect on material of PVC sheath.

1.4.3 Cable shall be suitable for laying in covered trenches and / or buried under-ground in outdoor.

1.4.4 Cable Parameters :

| | | | **11 KV** |
|---|---|---|---|
| (i) | Voltage grade (Uo / U) KV | : | 6.35 / 11 |
| (ii) | Cores (Nos) | : | 3 |
| (iii) | Nominal system voltage KV | : | 11 |
| (iv) | Highest system voltage KV | : | 12 |
| (v) | System frequency Hz | : | 50 |
| (vi) | Variation in frequency % | : | ± 3 |
| (vii) | (a) Maximum allowable temp. of conductor during continuous normal operation at rated full load current. $^0$C | : | 90 |
| | (b) Maximum allowable temp. under short circuit condition $^0$C | | 250 |
| (viii) | 1.2/50 microsecond lightning impulse withstand voltage wave value. KVp | : | 75 |
| (ix) | 5 Min, Power frequency withstand voltage KV rms | : | 17 |
| (x) | System earthling | | Effectively Earthed |

**1.5 GENERAL TECHNICAL REQUIREMENTS:**

1.5.1 Conductor:

The cable conductor shall be made from high conductivity stranded High Density aluminum to form compacted circular shaped conductor having resistance within limits specified in IS: 8130/1984 and any latest amendment to it.

1.5.2 Conductor shield:

The conductor having semi-conducing screen shall ensure perfectly smooth profile & avoid concentration of stress. The conductor screen shall be extruded in the same operation as the insulation. The semi-conducting polymer shall be cross linked.

1.5.3 Insulation:

The XLPE insulation shall be suitable for 11 KV system voltage and should be manufactured with Dry / Gas curing process. The bidder shall submit the description of dry / gas curing process, with the clear inclusion of equipments / parameters involved. The manufacturing process shall ensure that the insulation shall be free of voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cable shall be of high standard quality generally conforming to IS: 7098 (Part – II) – 1985 and any latest amendment to it.

1.5.4 Insulation shield:

Non-metallic semi-conducting shield shall be provided over the insulation to confine electrical field to the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by suitable extrusion process. The XLPE insulation shield shall be of tended type. The copper metallic overlapped tape shield shall be provided.

1.5.5. Filler and Inner-Sheath:

Fillers and Inner-sheath should be confirming to IS: 7098(Part-II)-1985. The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of consistent quality and free from all defects. The PVC sheath shall be extruded. The material of fillers and inner-sheath shall be compatible with the temperature ratings of the cable and shall have no deleterious effect on any other component of the cable. Central filler shall also, be provided with other peripheral fillers to have proper circular section.

1.5.6 Armour:

Armouring of galvanized steel strip shall be provided. The dimensions of steel strips shall be as per latest edition of IS: 3975 – 1979.

1.5.7 Outer-Sheath:

Extruded type ST-2 PVC outer-sheath, conforming to IS: 5831-(1984) (latest edition) over armouring with suitable additives (to prevent attack by redents & termites), shall be provided.

1.5.8 Construction:

1.5.8.1 The cable shall have suitable fillers laid up with insulation cores to have subsequently circular cross-section before the inner sheath is applied. The fillers shall be suitable for operating temperature of the cable.

1.5.8.2 All materials used in manufacturing of cable shall be new, unused and of finest quality. All materials should comply with the requirements / tests as per applicable IS / IEC specification, Indian Electricity Rules and any other statutory provision of rules & regulations.

1.5.8.3 The PVC material used in the manufacture of cable shall be of reputed manufacturer. No recycling of PVC is permitted. The purchaser reserves the right to ask for documentary evidence of the purchase of various materials, (to be used for the manufacture of cable) as per checking of quality control. Quality Assurance plans shall be submitted.

1.5.9 Current Rating:

The indicative values of continuous current carrying capacities at Maximum conductor temperature of 90°C (for design purpose by field) of the various sizes of the cables are given below:

| Sr. No. | Size of 3 Core Cable (Sq.mm) | Continuous Current Carrying Capacity in Amp (For 11 KV cable) | |
|---|---|---|---|
| | | in Ground | in air |
| 1 | 95 | 185 | 200 |
| 2 | 150 | 235 | 265 |
| 3 | 185 | 270 | 310 |

1.5.9.1 Short circuit ratings of various sizes of 3 core cable calculated for duration of one second at maximum temperature of $250^0$ C, are given below:

| Sr. No. | Size of 3 Core Cable (Sq. mm) | Conductor short circuit rating in kA (rms) (For 11 KV cable) |
|---|---|---|
| 1 | 95 | 8.93 |

| | | |
|---|---|---|
| 2 | 150 | 14.1 |
| 3 | 185 | 17.4 |

1.5.9.2 The current rating shall be based on maximum conductor temperature of $90^0$ with ambient site condition specified for continuous operation at the rated current.

1.5.10 Operation :

1.5.10.1 Cable shall be suitable for operation under frequency variation of ±3% and voltage variation of +10% to -15% and combined frequency - voltage variation of 10% (absolute sum).

1.5.10.2 Cable shall be suitable for laying in duct or burried underground.

1.5.10.3 Cable shall have heat & moisture resistance properties. These shall be of type & design with proven record on distribution network service.

1.5.10.4 Length :

The cable shall be supplied in standard drum length of 300 mtrs. ± 5% tolerance for all the sizes of cable except for 3 C x 240mm$^2$ and 3 C x 300 mm$^2$ size cable. The drum length for 3 C x 240mm$^2$ and 3C x 300 mm$^2$ cable shall be 200 mtrs. ± 5%. ***Over all tolerance in total quantity of ordered cables shall be ± 2%.***

1.5.10.5 Identification Mark:

(i) The cable drum shall be printed with information as per cl. 21.2 of IS and ISI Certification mark. **Bidder shall submit attested photo copy of valid ISI Licenses with technical bid.**

(ii) For identification of cores, coloured strip of Red, Yellow and Blue colours shall be used for identification of phases. Following details of identification shall be embossed at intervals of length of one meter of cable outer sheath.

(iii) (a) Name of manufacturer (b) year of manufacture (c) voltage grade (d) Name of purchaser "PGVCL/UGVCLMGVCL/DGVCL".

**1.6 TESTS:**

1.6.1 (A) Type Tests:

All the cable sizes i.e. items offered should have been fully type tested as per the relevant standards at **any Govt. recognized Laboratory**.

The bidder shall furnish the type test reports along with the offer. These type tests must have been conducted within last seven years prior to date of Bid opening. For any change in design/type, already type tested and the design / type offered against this specification, the purchaser

reserves the right to demand reputation of type tests without any extra cost.

The purchaser also reserves the right to have tests carried out at his own cost by an independent agency, whenever there is a dispute regarding the quality of supply.

1.6.1 (B) Type tests certificates for following type tests shall be furnished invariably with the offer:

(a) Tests on conductor :
  (i) Tensile test
  (ii) Wrapping test
  (iii) Resistance test
(b) Tests for armouring strips / wires. :
(c) Tests for thickness of insulation and sheath. :
(d) Physical tests for insulation. :
  (i) Tensile strength and elongation at break.
  (ii) Ageing in air oven
  (iii) Hot set
  (iv) Shrinkage test
  (v) Water absorption

(e) Physical tests on outer sheath :
  (i) Tensile strength and elongation at break.
  (ii) Ageing in air oven
  (iii) Shrinkage test
  (iv) Hot deformation
(f) Partial discharge test
(g) Bending test
(h) Dielectric power factor test
  i) as a function of voltage
  ii) as a function of temperature
(i) Insulation resistance test (volume resistivity)
(j) Heating cycle test
(k) Impulse withstand test
(l) High voltage test
(m) Flammability test

1.6.2 Acceptance Test:

1.6.2.1 The selection of samples for acceptance test shall be as under.

| No. of drums in the lot | No. of drums to be taken as sample | Permissible No. of Defectives |
|---|---|---|
| Up to 25 | 3 | 0 |
| 26 to 50 | 5 | 0 |
| 51 to 100 | 8 | 0 |
| 101 to 300 | 13 | 1 |

| | | |
|---|---|---|
| 301 and above | 20 | 1 |

1.6.2.2 The following acceptance tests shall be carried cut on the selected samples as per IS: 7098 (Part-II) – 1985.

(a) Annealing test (for copper)
(b) Tensile test (for aluminum)
(c) Wrapping test (for aluminum)
(d) Conductor resistance test.
(e) Test for thickness of insulation and sheath
(f) Hot set test for insulation
(g) Tensile strength and elongation at break test for insulation and sheath.
(h) Partial discharge test (for screened cables only)
(i) High voltage test for 4 hours (as per cl. No. 19.7.1)
(j) Insulation resistance (volume resistivity) test.

1.6.2.3 All the acceptance tests shall be carried out by the firm, in the presence of purchaser's representative at their works. The firm shall give at least 15 days' advance notice to the purchaser to enable him to depute the engineer for witnessing the tests.

The test certificates for acceptance tests witnessed by inspecting officer/ engineer shall be submitted for approval before dispatch of material.

1.6.3 Tests:

1.6.3.1 The bidder shall have to submit, well in advance, the test certificates for the following routine test for approval prior to inspection of the materials for the complete lot offered for inspection at a time.

(a) Conductor resistance test
(b) Partial discharge test
(c) High-voltage test for 5 minutes [as per Clause 19.7.2 of IS: 7098 (Part-II) – 1985].

## 1.7 STAGE INSPECTION:

1.7.1 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at reasonable time, when the work is in progress. Inspection and acceptance, of any cables under this specification by the purchaser, shall not relieve the supplier of his obligation of supplying cable in accordance with the specification and shall not prevent subsequent rejection, if the cables are found defective.

1.7.2 The supplier shall keep the purchaser informed in advance about the programme of manufacturing of cables so that arrangement can be made for inspection.

1.7.3 The purchaser reserves the right to insist for witnessing the acceptance / routing tests of the bought out items.

**1.8 DOCUMENTATION:**

1.8.1 The bidder shall furnish following documents along with his offer in "EMD Cover Document"

1.8.1.1 Sectional view, showing the General constructional feature with conductor / conductor screen / insulation / armouring / inner and outer sheath etc.

1.8.1.2 Drawing of cable drums with details of material dimension and paint etc. shall be submitted.

1.8.1.3 **All the required type test reports for offered items tested at any Government recognized Laboratory as stated under Clause No. 1.6.1 (B).**

1.8.1.4 Literature, pamphlets for the record items.

1.8.1.5 List of orders (size wise) executed during last Three years for supply of specified sizes of XLPE cables, supplied to State Electricity Boards, Private firms & MGVCL/DGVCL/UGVCL/DGVCL/GETCO/GUVNL(formerly GEB) etc. alongwith quantity, value of the orders, year of supply and delivery schedule. List of orders executed and under execution shall be submitted separately. The annual turn over in rupees, of the firms to whom the cables have been supplied during last two years shall be stated.

**1.9 PACKING AND FORWARDING:**

1.9.1 The cable shall be wound on wooden drums as per IS: 10418 – 1972 and packed in drums suitable for vertical / horizontal transport, as the case may be and shall be suitable to withstand rough handling during transport and outer storage.
The outer surface of the drum shall be painted with white aluminum pint. Similarly, the inside surface of drum shall have the protective layer of varnish / paint to protect it from white ants.

1.9.2 The wooden drums shall be reinforced with steel bends and strips for better protection.

1.9.3 The ends of the cable shall be sealed by means of non-hygroscopic sealing materials.

1.9.4 The following information may be stenciled on the drum with either water proof ink or oil paint:

i. Reference of IS / IEC standard.

ii. Manufacturer's name or trademark.

iii. Type of cable and voltage grade.

iv. No. of cores.

v. Nominal cross-sectional area of conductor.

vi. Cable code.

vii. Length of cable on the drum

viii. No. of lengths on the drum (if more than one)

ix. Direction of rotation of drum (by means of an arrow)

x. Position of outer end of cable

xi. Gross weight

xii. Country of manufacture

xiii. Year of manufacture

xiv. Reference of A/T No. & date

xv. Property of PGVCL/UGVCL/MGVCL/DGVCL

xvi. Name of consignee and the destination.

**The drum may also be marked with ISI Certification Mark.**

Over and above, name plate of aluminum of suitable size and thickness, containing all the above information, shall be fixed on the drum in addition to the painting.

1.9.5 The firm shall be responsible for any damage to the cables during transit due to improper and inadequate packing. Wherever necessary, proper arrangement for lifting, such as lifting hooks, shall be provided. Any cable found short inside the packing cases shall be supplied by the supplier, without any extra cost.

1.9.6 Each consignment shall be accompanied by a detailed packing list, containing the following information:

(a) Name of consignee

(b) Details of consignment

(c) Destination

(d) Total weight of consignment

(e) Handling and unpacking instruction

(f) Bill of materials, indicating contents of each package.

**1.10 TECHNICAL AND GUARANTEED PARTICULARS:**

The bidder shall furnish all Guaranteed Technical Particulars, as called for, in **Appendix - I** of this Specification. Particulars, which are subject to guarantee, shall be clearly identified. Offer not containing these information will not be considered for acceptance.

**1.11 PERFORMANCE CERTIFICATE:**

Bidders shall also submit performance reports for the specified size of cables supplied to other State Electricity Boards / reputed firms, with the clear indication of the period since when the cables performed satisfactory service.

**1.12 LEGIBLE SUBMISSION:**

Only required relevant, legible documents shall be submitted to avoid delay due to back reference.

## APPENDIX – I

## SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 11KV XLPE POWER CABLE (G.T.P.)

**(To be filled in and signed by the Tenderer)**

| | | | | |
|---|---|---|---|---|
| 1.00.0 | **GENERAL:** | | | |
| 1.01.0 | Name of Manufacturer | : | | |
| 1.02.0 | Place of Manufacturing | : | | |
| 1.03.0 | Applicable standard IS/IEC | : | | |
| 1.04.0 | Design ambient temperature $^0$C | : | | |
| 1.05.0 | Cable particulars, whether, confirmed, as per clause 1.5 of Section I of Technical Specification | : | Yes / No | |
| 2.00.0 | **CABLES:** | | **95mm²** | **185mm²** |
| 2.01.0 | Voltage grade (Uo / U) | : | | |
| 2.02.0 | Whether suitable for neutral earthed / unearthed System | : | | |
| 2.03.0 | Permissible voltage & frequency variation for satisfactory operation | : | | |
| 2.04.0 | Nos. of cores & size | : | | |
| 2.05.0 | Continuous current carrying capacity | : | | |
| 2.05.1 | For standard condition as per IS<br>1) In air (Amp.)<br>2) In ground ( " )<br>3) In duct ( " )<br>4) In trench ( " ) | :<br>:<br>:<br>:<br>: | | |
| 2.05.2 | For site condition<br>1) In air (Amp.)<br>2) In ground ( " )<br>3) In duct ( " )<br>4) In trench ( " ) | :<br>:<br>:<br>:<br>: | | |
| | | | | |
| 3.00.0 | **CONDUCTOR:** | | | |
| 3.01.0 | Material & its applicable IS. | : | | |
| 3.02.0 | Shape of conductor | : | | |
| 3.03.0 | Nominal cross section area (mm$^2$) | : | | |
| 3.04.0 | Number of wires per core | : | | |
| 3.05.0 | Nominal diameter & cross section area of each wire used in each core of the conductor | : | | |
| | | | | |

**Date Signature and seal of Tenderer**

| | | | | |
|---|---|---|---|---|
| 4.00.0 | **CONDUCTOR SCREENING:** | | | |
| 4.01.0 | Type | : | | |
| 4.02.0 | Material & its applicable IS. | : | | |
| 4.03.0 | Continuous working temp $^0$C | : | | |
| 4.04.0 | Nominal thickness (mm) | : | | |
| | | | | |
| 5.00.0 | **INSULATION:** | | | |
| 5.01.0 | Material & its applicable IS | : | | |
| 5.02.0 | Thickness of insulation (mm)<br>a) Between cores<br>b) Between cores & inner sheath | :<br>: | | |
| 5.03.0 | Tolerance in thickness (percent) of insulation | : | | |
| 5.04.0 | Diameter of core over insulation (mm) | : | | |
| 5.05.0 | Specific insulation resistance at ninety (90) degree Centigrade (Ohm-Cm) | : | | |
| 5.06.0 | Whether insulation is removable without damaging the conductor | | | |
| | | | | |
| 6.00.0 | **INSULATION SCREENING:** | | | |
| 6.01.0 | Material & its applicable IS. | : | | |
| 6.02.0 | Thickness (mm):<br>1) Semi-conducting part<br>2) Metallic part (copper tape) | :<br>: | | |
| 6.03.0 | Whether overlapping provided for copper tape | : | | |
| 6.04.0 | Current carrying capacity<br>a) Continuous (Amps.)<br>b) S.C. current duration of 3-Sec. (KA) | :<br>:<br>: | | |
| 6.05.0 | Diameter of core over screening (mm) | : | | |
| | | | | |
| 7.00.0 | **FILLER:** | | | |
| 7.01.0 | Material & its applicable IS | : | | |
| 7.02.0 | Whether suitable for operating temperature of Cable (Yes/ No) | : | Yes/ No | Yes/ No |
| 7.03.0 | No of fillers provided including central filler | : | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| 8.00.0 | **INNER SHEATH:** | | | |
| 8.01.0 | Material & its applicable IS | : | | |
| 8.02.0 | Extruded or wrapped | : | | |
| 8.03.0 | Thickness (mm) | : | | |
| 8.04.0 | Diameter of cable over inner-sheath (mm) | : | | |
| | | | | |
| 9.00.0 | **ARMOURING:** | | | |
| 9.01.0 | Material & its applicable IS | : | | |
| 9.02.0 | Type of armouring | : | | |
| 9.04.0 | Nos. of strips | : | | |
| 9.05.0 | Diameter of cable over armouring | : | | |
| 9.06.0 | Current carrying capacity of armour<br>a) on continuous basis (Amp)<br>b) short circuit current duration of 1 sec (KA) | :<br>:<br>: | | |
| | | | | |
| 10.00.0 | **OUTER SHEATH:** | | | |
| 10.01.0 | Material & its applicable IS. | : | | |
| 10.02.0 | Thickness of sheath | : | | |
| 10.03.0 | Tolerance on thickness of sheath | : | | |
| 10.04.0 | Over all diameter of cable (mm) | : | | |
| 10.05.0 | Scheme for identification | : | | |
| | | | | |
| 11.00.0 | **CABLE CONSTANT:** | | | |
| 11.01.0 | AC resistance per core at operating temp. (Ohm/KM) | : | | |
| 11.02.0 | DC resistance per core at $20^0$C (Ohm/KM) | : | | |
| 11.03.0 | Reactance per core (Ohm/KM) | : | | |
| 11.04.0 | Capacitance per core (Microfarad/ KM) | : | | |
| 11.05.0 | Insulation resistance at $27^0$C (Ohm/ KM) | : | | |
| 11.06.0 | Loss tangent | : | | |
| 11.07.0 | Dielectric constant | : | | |
| 11.08.0 | Maxi. Cable charging current at normal operating voltage (Amp/KM) | : | | |
| | | | | |
| 12.00.0 | **OTHER PARAMETERS:** | | | |

| | | | | |
|---|---|---|---|---|
| 12.01.0 | Recommended minimum braiding radius (mm) | : | | |
| 12.02.0 | Safe pulling force | : | | |
| 12.03.0 | Cable weight (Kg./KM) | : | | |
| | | | | |
| 13.00.0 | **CABLE DRUM:** | | | |
| 13.01.0 | Net weight of cable (Kg.) | : | | |
| 13.02.0 | Drum weight (Kg.) | : | | |
| 13.03.0 | Shipping weight (Kg.) | : | | |
| 13.04.0 | Whether ISI Mark shall be indicated on drum | : | Yes/ No | Yes/ No |
| 13.05.0 | Length of cable per drum (Meter) | : | | |
| | | | | |
| 14.00.0 | Whether details shall be embossed as stated under Cl. 1.9.4 of Technical Specification | : | Yes/ No | Yes/ No |
| 15.00.0 | Whether type test reports submitted, as stated under Cl. 1.6.1 of Technical Specification | : | Yes/ No | Yes/ No |
| 16.00.0 | Whether drawings submitted as specified under Cl. 1.8.1 of Technical Specification. | : | Yes/ No | Yes/ No |
| 17.00.0 | Whether unpriced schedule of offered items submitted with Technical offer. | : | Yes/ No | Yes/ No |

**Agreed for page no.1 to 14 as above,**

**IMPORTANT NOTE: Please sign & seal on each page above. It is mandatory**

**Date Signature and seal of Tenderer**